PATENT

**UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Goretta, et al.

Title: "JOINING OF ADVANCED MATERIALS BY PLASTIC DEFORMATION"

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CERTIFICATE OF MAILING: I hereby certify that this correspondence is being deposited per 37 C.F.R. 1.8 with the United States Postal service as first class mail in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C,. 20231 on January 5, 2003 (Date of Deposit)

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## DECLARATION UNDER 37 C.F.R. 1.132

I, Jules Routbort, co-inventor of the invention claimed in United States Patent Application No.: 09/924,571 hereby declare that:

1. I have been a Scientist (now Senior Scientist) in the Materials Science Division of Argonne National Laboratory, Argonne, IL, since 1968. My duties at Argonne include the development of ceramic materials for use at high temperatures under high stresses.

2. I received a Bachelor of Science degree in Engineering Physics (honors) from University of California, Berkeley, in 1960. I received a PhD in Engineering Physics from Cornell University, Ithaca, NY in 1965.

3. Prior to my employ at Argonne, I was a Postdoctoral Research Associate at Cavendish Laboratory in Cambridge, England (1964-1966) and at Rensselaer Polytechnic Institute, Troy, NY (1966-1968). My teaching appointments include a full adjunct professorship in the Department of Metallurgical and Materials Engineering at Illinois Institute of Technology (since 1986) and also at the Department of Materials Engineering at North Carolina State University, Raleigh, NC (since 1984).

4. I have at least 250 papers and 220 published abstracts in the area dealing with material science, primarily ceramics. Exemplary journals include *Acta Metallurgia, Scripta Metallurgia, Physical Review, Applied Physics Letters, Journal of the American Ceramic Society, Journal of the European Ceramic Society, J. Materials Engineering, Materials Science,* and *Materials Science Letters.* Most recent representative papers include "Influence of internal stresses in superplastic joining of zirconia toughened alumina", Acta Mateialia 50 3475-3486 (2002), and "Creep of $(La_{0.55}\ Sr_{0.45})_{0.99}\ Mn_{1-y}Ga_y\ O_3$" 5, 2232-2236 (2003).

5. I have organized at least 10 conferences dealing with ceramics, their defects and related properties. I was the editor on two proceedings dealing with defects and deformations in ceramics.

6. Currently, I am on the Scientific Advisory Committee of Ceramica acta (since 1989), and an Associate Editor for Applied Physics Letters (since 1990).

7. In 1973/74, I received the Alexander von Humboldt Fellowship to study diffusion in nuclear fuels. In 1981/82 I received an Euratom Fellowship to investigate fracture properties of glasses and ceramics. In 1987 I was named a Fellow of the American Ceramic Society. In 1999 I was awarded an Iberdola Prize to investigate the high-temperature mechanical properties of ceramics.

8. I wish to clarify that the instant invention for producing a construct by seamlessly joining solid objects occurs via diffusion of particles, not by reactive processes between particles. The resulting construct which is produced has a seamless topography, and this occurs via super plastic deformation. This superplastic deformation occurs between the objects and the joint compound interposed between the objects.

9. I am the co-inventor of a method for joining together objects using superplastic deformation, which is the subject of this patent application. I have studied the Xue prior art cited by the Examiner. Generally, that prior art discloses the use of a reactive joint compound for joining carbon objects. In the field of joining objects, the Xue art is presented as an alternative mechanism to chemical adhesives, welding, diffusion bonding and/or superplastic deformation.

10. Superplastic deformation is a diffusion-controlled process whereby nanosize particles effect seamless joints via grain boundary sliding. By its nature, boundary sliding occurs only if particles maintain their physical dimension and integrity so as to allow the particles to diffuse and intermingle with particles of contacting structures. Super Plastic Forming (SPF) and Diffusion Bonding (DB) are hot working manufacturing techniques. SPF is used in conjunction with DB to produce complex, high strength components from a single manufacturing operation.

11. Xue's reliance of up to 100 micron particle sizes, and even 5 mm long carbon fibers in its joint compound is evidence that grain boundary sliding, and therefore superplasticity is absent in Xue. Grains cannot slide over these obstacles. Such large particle sizes and also a lack of any provision in Xue for the relative particle sizes of the carbon objects to be joined, negates any superplasticity from developing. Xue relies on reactivity between its compound and the objects to be joined. Our invention relies on grain boundary sliding accommodated by diffusion.

12. The undersigned declares that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and may jeopardize the validity of any resulting patent.

IN WITNESS WHEREOF, I have signed, sealed, and delivered this instrument this 20 th day of December, 2005.

Jules Routbort, PhD